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The Study of the Uniformity of the Depth of Immersion of the Roller, A Universal Device Used in Tillage Before Planting

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Abstract: In the article, the uniformity of the depth of immersion of the roller of the universal device into the soil and the density of the soil depends on its mass, the length of the tie connecting it to the frame, the length of the pressure spring, the amplitude of the variable force, and the physical and mechanical properties of the soil. is achieved due to the correct selection of the length of the spring.

Key words: universal device roller, depth of immersion into the soil, frame, traction, pressure spring, physical and mechanical properties of the soil, working bodies, aggregate movement speed.

Introduction. The depth of cultivation and its stability (evenness) are the main performance indicators of all tillage machines. If the tillage depth is at the required level and its stability is ensured, i.e. it is uniform, uniform development and ripening of crops and a high yield are achieved, otherwise, i.e. if the specified tillage depth and its stability are not ensured - uneven development and ripening of plants is observed, productivity decreases. For this reason, there are strict requirements and restrictions on the working depth and its deviations (unevenness) for each tillage machine.

On the basis of these points, we have conducted research aimed at ensuring that tillage machines used in the agriculture of our country sink to the specified processing depth and ensure stable movement at this depth.

In this article, the roller of the universal device is hinged with its frame by means of a tensioner, and in the process of work, it sinks into the soil to a certain depth. Its main function is to uniformly compact the layer processed by the universal device's arrow-shaped claws and milling cutter at the level of demand and throughout the entire layer. In order to achieve this, the depth of immersion of the roller into the soil and its uniformity are important.

Figure 1.1 shows the possible connection schemes of the winding with the device frame. When the roller is connected to the frame according to the "a" scheme, the tension OO1, which connects them, occupies a horizontal position during the working process, when it is connected according to the "b" scheme, the tension works downwards relative to the horizontal position during the work process, and when connected according to the "v" scheme, the tensioner works in the horizontal position during the work process working upwards.

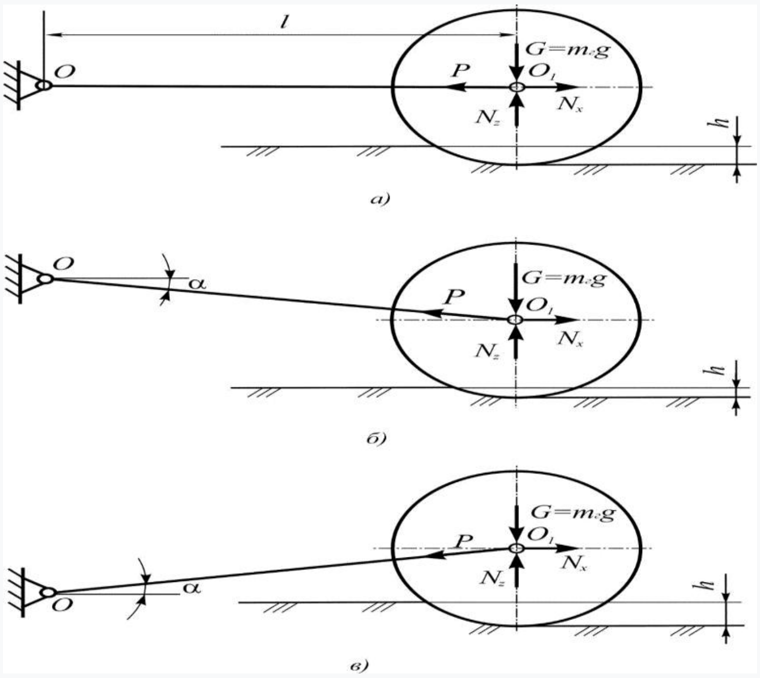

Figure 1.1. Schemes of connection of the universal device coil with its frame

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Using the schemes presented in Figure 3.1, we determine the vertical compressive force exerted by the roller on the soil

$$Q_{б} = N_{z} = G \mp P\sin\alpha = m_{г}g \mp P\sin\alpha, \quad (1.1)$$

where Qb is the vertical compressive force applied to the soil by the roller, N;

Nz is the reaction force acting on the coil by the ground

vertical organizer, N;

G is the weight of the roller, N;

P is the pulling force applied to the reel by the tow, N;

a - the tension connecting the reel to the frame relative to the horizon

deviation angle, N;

mg – mass of the roller, kg;

g - free fall acceleration, m/s2.

In the expression (1.1), the sign "–" is placed when the tow is deviating from the horizontal position downwards, and the sign "+" is placed when it is deviating upward.

In the first case, i.e., when the tractor is working in a horizontal position, the traction force applied to the roller does not affect the pressure force exerted by it on the soil, and its gravity is fully used to compact the soil.

In the second case, i.e., the traction force exerted on the roller tends to raise it from the ground, even though the drag is working downwards from the horizontal position. Therefore, the pressure force of the roller on the soil is less than its weight, that is, in this case, the weight of the roller is not fully used to compact the soil. It should also be noted that the greater the angle of deviation of the tractor from the horizon, the lower the pressure force of the roller on the soil. Therefore, in this case, in order to compact the soil to the required level, a greater gravity is required than in the first case.

In the third case, gravity presses the roller to the ground. As a result, the compressive force of the roller is greater than the force of its weight. Therefore, in this case, a minimum weight force is required to compact the soil to the required level. This, in turn, leads to a decrease in material volume.

We reduce the expression (1.1) to the following form

$$Q_{б} = m_{г}g \mp \frac{\mu_{г}\sqrt{N_{x}^{2}+N_{z}^{2}}}{\sqrt{1+\mu_{г}^{2}}}tg\alpha, \quad 1.2$$

where mg is the rolling coefficient of the roller;

N_x is the reaction force acting on the coil by the ground

horizontal organizer, N.

It is known that the reaction forces Nx and Nz acting on the coil during operation are constantly changing due to the variability of the physical and mechanical properties of the soil.

As can be seen from the expression (1.2), for this reason, when the tension connecting the roller with the frame deviates downward or upward relative to the horizon, the pressure force Qb of the roller on the soil remains variable, and as a result, the soil is unevenly compacted. This, in turn, has a negative effect on the quality and germination of seeds.

According to the expression (1.2), when the tension connecting the roller to the frame is horizontal, the forces N_x and N_z do not affect Q_b, that is, it has a constant value. A_s a result, the soil is uniformly compacted throughout the entire field, and the seeds are sown and germinated evenly.

Based on the above, laboratory-field experiments were carried out on the background treated with a chisel-cultivator equipped with a softener and arrow-shaped claws at a depth of 18-20 cm, and the position of the tie rod connecting the roller with the frame relative to the horizon was determined by the density and hardness of the soil in the 0-10 cm layer and their average hardness. influence on quadratic deviations (and therefore uniformity) was studied. In the experiments, the tow truck was installed in 20° inclined up and down and horizontal positions. This was achieved by moving the point O (Fig. 1.1) up and down.

During the experiments, the drag length was 350 mm, the roller diameter was 300 mm, the coverage width was 1.0 m, the mass was 125 kg, and the speed of movement was 1.8 m/s.

Before conducting the experiments, soil moisture, density and hardness in the 0-10 and 10-20 cm layers were determined using existing methods in six replicates. Their average values were 13.8 and 16.4 percent, 1.07 and 1.13 g/cm3, and 0.34 and 0.98 MPa, respectively.

CONCLUSION

So, according to our studies, in order to ensure even and effective compaction of the soil, the roller of the universal device used in tilling the land before planting should be in a horizontal or upward position during the work process.

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